7.3.1 Description

Subsurface soil filters including a detention/retention bed of chambers may only be approved as an alternative BMP design on a case-by-case basis as they generally require much more care in their design, construction and maintenance. Subsurface sand filters are viewed as having a higher risk of failure and should not be considered unless all other alternatives have been considered and deemed impracticable because of the compaction necessary for bearing strength that is usually required of subsurface systems, because there is no vegetation to insure long term permeability, to provide evapo-transpiration or a long-term source of organic matter; and because there is no track record on this type of system (only on sand filters).

StormTech Isolator Row
The StormTech Isolator Row system is designed as part of the sites overall detention/retention system and provides the pretreatment requirement as it is mandatory for a subsurface sand filter BMP. The fabric-wrapped chambers provide for settling and filtration of contaminants including: sediment, metals and hydrocarbons as stormwater rises in the Isolator Row and ultimately passes through the filter fabric. Sediments are captured in the Isolator Row protecting the storage areas of the adjacent stone and chambers from sediment accumulation and the open bottom chambers allow stormwater to flow vertically out of the chambers. The chambers and the surrounding aggregate are designed to store the stormwater runoff and release the runoff at attenuated rates. This detention of the runoff in the chambers and aggregate also cools the runoff reducing the thermal impacts downstream of the system.

A subsurface soil filter must meet the following criteria:

1. Drainage Area: The drainage area contributing to a subsurface underdrained sand filter is sized based on the storage capacity over the filter and within the structure.
2. Depth to Groundwater: The bottom of the underdrain sand filter should be one foot above the seasonal high groundwater table at a minimum.
3. Bedrock: The top of bedrock may be no closer than 1 foot from the bottom of the underdrained sand filter.

7.3.2 General Design and Construction Criteria

Treatment Volume: An underdrained subsurface filter must detain a runoff volume equal to 1.0 inch times the subcatchment's impervious area plus 0.4 inch times the subcatchment vegetated area.
Impoundment Depth: The peak surface storage depth within the chamber system for the water quality volume may not exceed 18 inches. Additional storage may be provided for the volume of runoff needing detention to meet the flooding standards.
System Size: The surface area of the sand filter bed and chamber system must be at least equal to 5% of the impervious area draining to it and 2 % of the landscaped area.
Outlet: The treatment volume must be discharged solely through an underdrain sand bed and underdrain piping system having a single outlet with a diameter no greater than eight inches or through a proprietary filter

system approved by the Department.
Site Stabilization: The site must be completely stabilized before construction of the subsurface sand filter is to begin.
Erosion Control: Prevent sediment from reaching the Isolator Row during construction until the site is stabilized is extremely important. An Isolator Row receiving sediment from an unstabilized site will have accumulated sediment that may affect the design flow rates of the Isolator Row and require cleaning prior to system use.
Construction Components: Underdrained chamber systems are constructed in an excavated area that is at least 5 ft deep and consisting of the following:

- A geotextile fabric between the natural subbase soils and constructed media.
- A 12 to 14 inch base of coarse clean stone with a system of 4 to 6-inch perforated drainage pipe.
- A layer of well compacted sand filter media at least 18 inches thick,
- Transition layers, as needed, to provide separation between the different gradation (between the drainage layer, the soil filter bed and the chamber backfill) without using geotextiles which have been found to clog.

7.3.3 Specific Design Criteria

Underdrain Pipe: Proper layout of the pipe underdrain system is necessary to effectively drain the entire filter area. There must be at least one line of underdrain pipe for every eight feet of the filter area's width. The underdrain piping should be 4" to 6" slotted, rigid schedule 40 PVC or SDR35. An orifice may be needed to ensure that the channel protection volume is slowly released over 24 to 36 hours.
Pipe Bedding and Transition Zone: The underdrain pipe(s) must be bedded in a minimum of 12 of underdrained material with at least 4 inches of material beneath the pipe and 4 inches above. The underdrain bedding material must consist of clean gravel meeting the MEDOT specification 703.22 Underdrain Type C for Underdrain Backfill Material (see Table 7.1). Crushed stone bedding material may be used; however it will need to be covered with a 6 inch layer of well graded, clean, coarse gravel meeting the MEDOT specification 703.22 Underdrain Type B for Underdrain Backfill Material (see Table 7.1). Fines passing the #200 sieve in the gravel should be no more than 5% (preferably 2%). Underdrain pipes should be placed 8 feet apart.

TABLE 7.1 Maine DOT Specifications for Underdrains (MEDOT #703.22)

Sieve Size	**% by Weight**
UNDERDRAIN - TYPE B	
1”	90-100
½”	75-100
#4	50-100
#20	15-80
#50	0-15
#200	0-5
UNDERDRAIN - TYPE C	
1”	100
¾”	90-100
3/8”	0-75
#4	0-25
#10	0-5

TABLE 7.2 Maine DOT Specifications for Aggregate (MEDOT #703.01)

Sieve Size	**% by Weight**
3/8”	100
#4	95-100
#8	80-100
#16	50-85
#30	25-60
#60	10-30
#100	2-10
#200	0-5

Sand Filter Bed: The sand filter must be at least 18 inches deep on top of the gravel underdrain pipe bedding and must extend across the bottom of the entire filter area. This

sand material shall be a uniform mix, free of stones, stumps, roots, or other similar objects larger than two inches. The preferred material should have minimal clay content but contain between 8% and 10% fines passing the #200 sieve but should meet the other specifications in Table 7.2 for sieve size 3/8" to #100. The material should drain within 24 and 48 hours after compaction. The material will need to be submitted to a rigid testing protocol to insure adequate permeability at the anticipated level of compaction (92 to 95% Proctor). The permeability of the material will decrease due to compaction and the amount of fines may be adjusted to maintain the expected drainage time.

Pre-Treatment: Pre-treatment will be required and will include the StormTech Isolator Row or an equally effective sediment removal technology and additional pre-treatment for hydrocarbons by a combination of gravity (floatation) or absorption. A 5-year maintenance contract for regular seasonal inspection of the system and for cleaning the pretreatment device will be required. Pretreatment must include a strategy to attenuate hydrocarbons, often located in the catchbasins that drain to the filter.

7.3.2 Site Suitability Criteria

Drainage Area: The required number of Isolator Row chambers is based on the size and land use within the area draining to the chambers.

Depth to Groundwater: The bottom of the underdrain sand filter should be one foot above the seasonal high groundwater table at a minimum.

Bedrock: The top of bedrock may be no closer than 1 foot from the bottom of the underdrained sand filter.

Outlet: The channel protection volume is discharged through an outlet control structure. This structure is typically a standard manhole with a weir plate controlling the release rate from the chamber system via a series of orifices or weir crests. The outlet plate is designed based on a stage discharge relationship preventing downstream channel erosion. The outlet plate is designed to obtain the required 24 to 48 hour release time. The system outlet must discharge to an area capable of withstanding concentrated flows and saturated conditions without eroding.

Hydrocarbon Pretreatment: Pretreatment devices or practices such as sump skimmers, sorbent booms, or other similar devices shall be provided in catchbasins to minimize the discharge of hydrocarbons to the subsurface chamber system when the function of the draining area is a likely source of hydrocarbons (i.e. parking lots, roads, etc.).

7.3.3 Pretreatment Isolator Row General Design Criteria

The following design criteria apply to the designing treatment with the StormTech Isolator Row if used for pretreatment:

Treatment Flow Rate: The treatment flow rate for the StormTech Isolator Row system is the projected one year peak flow rate for the drainage area feeding the Isolator Row.

Sizing the Isolator Row: The treatment flow rate for the Isolator Row varies based on the chamber system specified. The treatment flow rates for the StormTech chambers are: 0.1 cfs for the SC-310 chamber, 0.2 cfs for the SC-740/DC-780 chambers, and 0.3 cfs for the MC-3500 chamber. To determine the number of Isolator Row chambers, the one year peak flow rate must be divided by the specific flow rate of the specified chamber. For example, a one year peak flow rate of 1.9 cfs would require 1.9/0.2 = 9.5 (rounded up to 10) SC-740 chambers in the Isolator Row (a minimum of 10 chambers). Additional Isolator Row chambers are acceptable based on site conditions and chamber bed layout.

Access/Diversion Structure: An adequately sized structure placed directly in front of the Isolator Row is required for inspection and maintenance. This structure will have a weir or elevation overflow manifold installed and should be a minimum of 48 inches to allow access to the Isolator Row. The actual size of the structure will vary based on the weir design, pipe sizes, pipe angles and flow rate over the weir. StormTech recommends

additional access structures when the length of the Isolator Row exceeds 50 feet. The structure may be added at the opposite end of the Isolator Row or inline with the Isolator Row at every 50 foot interval.

Multiple Isolator Rows: If inlets enter the detention/retention system at multiple locations an Isolator Row is required for each inlet point. If length of the number of chambers required exceeds the available length a second Isolator Row can be placed adjacent to the first Isolator Row however, a separate access structure is required for each additional row.

Isolator Row Flow Control Elevation: The elevation of this weir/manifold is typically set between the elevations of the midpoint of the chamber and the top of the chamber.

Overflow: It is required to have an overflow on the Isolator Row directed towards additional storage chambers or a suitable location (direct to outlet, other storage devices, etc.)

Filter composition: Two layers of a woven geotextile fabric meeting AASHTO M288 specifications are placed between the stone and the Isolator Row chambers. This tough geotextile provides a media for stormwater filtration and provides a durable surface for maintenance operations. It is also designed to prevent scour of the underlying stone and remain intact during high pressure jetting. A layer of either woven or non-woven geotextile is required over the top of the SC-310 and SC-740 chambers to provide filtration for flow passing through the sidewalls of the chambers. This layer of fabric is optional for the DC-780 and MC-3500 chambers.

Connection Pipes: The connection pipes between the Isolator Row and the access/diversion structure are 12" for the SC-310 chambers and 24" for the SC-740, DC-780, and MC-3500 chambers.

7.6.4 Chamber System Construction Criteria

Manufactures Specifications: Install the chamber system in accordance with the manufacturer's written installation instructions.

Excavation: The area of the basin may be excavated in preparation of the installation of the system. After excavation of the basin, the outlet structure and piping system must be installed at the appropriate elevation and protected with a sediment barrier. Excavation must be free of standing water. Dewatering measures must be taken if required.

Site Preparation: Prepare the chamber bed's subgrade soil as outlined in the engineer's drawings.

Requirement for subgrade soil bearing capacity should meet or exceed the chamber manufacturer's allowable subgrade soil bearing capacity.

Aggregate Backfill around the Chamber System: Clean, crushed, angular stone with a nominal size distribution of ¾ to 2 inches is required around the chambers. Stone designations meeting AASHTO M43 Nos. 3, 357, 4, 467, 5, 56, and 57 are acceptable. Granular fill above the stone is required per the manufactures specifications. Fills meeting AASHTO M43 Nos. 3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, and 10 are acceptable.

Construction Sequence: Erosion and sedimentation from unstable subcatchments could be a source of sediment entering the pre-treatment device. The runoff from the contributing drainage area must be diverted around the work area until stabilization is completed

Construction Oversight Inspection during and after construction and until the site is

Erosion Control:

Measures are to be taken to prevent sediment from reaching the Isolator Row during construction until the site is stabilized. An Isolator Row receiving sediment from an unstabilized site will have accumulated sediment that may affect the design flow rates of the Isolator Row and require cleaning prior to system use.

stabilized must be performed by the manufacturer's representative.

7.4.4 Maintenance Criteria

During the first year, the subsurface structure will be inspected semi-annually and following major storm events.

Maintenance Agreement: A legal maintenance agreement between the owner and an approved maintenance operator should be established with the specific descriptions of the responsibility of each for inspecting and maintaining any underdrained filter. The legal agreement establishing the entity should list specific maintenance activities (including timetables) and provide for the funding to cover long--term inspection and maintenance.

Soil Filter Inspection: Inspection ports will need to be installed within the underdrain gravel layer. At least one port needs to be installed per 500 square feet of subsurface structure. The system should be inspected after every major storm in the first few months to ensure proper function. Thereafter, the filter should be inspected at least once every six months to ensure that it is draining within 24 hours to 36 hours.

Pre-treatment device: Cleaning of the pre-treatment device shall be done as needed and identified by the entity holding the maintenance agreement as mandated under contract. Debris and sediment buildup within the Isolator Row fabric shall be removed as needed utilizing a Jet-Vac system. A routine inspection schedule needs to be established for each individual site based on site specific variables such as land use (i.e. road, industrial, commercial, residential, etc.) anticipated pollutant load, percent imperviousness, etc. The filter should be inspected at least once every six months to ensure that it is draining within 24 hours to 36 hours; however the inspection can be adjusted based upon previous observations of sediment deposition. When the average depth of sediment throughout the length of the Isolator Row exceeds 3 inches, clean-out must be performed.